

Exploring Augmented Reality Marketing in the Food and Beverage Industry using the TCCM Framework

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Abstract: - Augmented reality marketing represents an innovative approach, allowing businesses to deliver immersive experiences, increase customer engagement, and enhance brand visibility and sales. In the food and beverage industry, augmented reality holds the potential to transform consumer behavior by offering unique and interactive content tailored to food products. This paper aims to provide insights into the current research landscape of augmented reality marketing within the food and beverage industry. To achieve this, the TCCM framework, a widely adopted method for conducting reviews in management and marketing, is utilized to identify research gaps across four key dimensions: theory, context, characteristics, and methodology. Moreover, for expanding on the context aspect, the BICK FOUR (Branding-Inspiring-Convincing-Keeping) framework for augmented reality marketing is deployed. By combining these frameworks, the study offers meaningful guidance for both researchers and practitioners, highlighting current limitations and recommendations for future exploration of augmented reality marketing in the food and beverage industry.

Key-Words: - augmented reality, marketing; advertising; food and beverage, TCCM framework, BICK FOUR framework.

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1 Introduction

Augmented Reality (AR) is widely recognized as one of the most innovative and rapidly emerging technologies, steadily gaining popularity, [1]. It is an advanced technology or human-machine interaction tool that blends digital objects with the real world by merging physical and virtual environments, and enables real-time interactions, [2]. The AR market is expected to grow from \$46.6 billion in 2025 to \$62 billion by 2029. This substantial growth underscores the rising integration of AR technologies across diverse sectors for serving various goals, [3], [4]. AR has found applications across a wide range of fields, from medical training and surgical procedures in healthcare, [5], educational applications, [6], and entertainment, [7], to tourism, [8], supply chain management, [9], social media, [10], real-time guidance and maintenance in manufacturing, and even the food, beverage, and agriculture industries.

The Food and Beverage (F&B) industry is one of the oldest industries, with strategic significance in the global economy that is valued at about 9100 billion dollars, [11]. It is large, diverse, and constantly evolving. It often refers to a supply chain,

which is divided into three main stages: farming the sector responsible for gathering raw materials and transforming them into essential staple food, such as rice or corn; processing, the stage where raw materials or staples are converted into consumable food products; and distribution the process of delivering and selling finished or near-finished products through grocery stores, supermarkets, or restaurants, [12]. Processing encompasses activities, such as meat and cheese processing, soft drink manufacturing, packaged food development, and the creation of alcoholic and non-alcoholic beverages and other processed food products. This excludes foods derived directly from agricultural practices, which are classified under the farming stage. The distribution, on the other hand, is entirely focused on consumers, aiming to deliver the food products to them. It includes all companies involved in transporting food to consumers, restaurants, and retail outlets, [13].

In recent years, the growing demand for sustainable, high-quality, and safe food products has driven the F&B industry to adopt innovative technologies that transform food production, processing, distribution, marketing, and

consumption, [14]. F&B businesses are increasingly adopting this technology to enhance productivity, improve efficiency, and reduce costs, [4]. Particularly for marketing, AR has emerged as a transformative technology in the F&B industry by offering immersive experiences and providing unique opportunities. Augmented Reality Marketing (ARM) represents a novel approach that offers businesses new ways to deliver interactive content, enhance customer engagement and entertainment, and increase brand visibility, ultimately driving sales growth and overall satisfaction, [15].

Nevertheless, there is evidence from literature that there is a lack of research on how ARM and the food sector are connected, offering an opportunity to explore this area, [16], [17]. Therefore, the objective of this paper is to examine the state-of-the-art of research on ARM in the F&B industry. The study tries to answer the following research questions (RQs) concerning ARM within the F&B industry:

RQ1. What research advancements have been identified?

RQ2. What application areas and contexts have been identified?

RQ3. What methodological approaches and theories have been utilized?

RQ4. What future research opportunities could be highlighted?

To answer the research questions, firstly, the current relevant bibliography is identified through the PRISMA 2020 methodology. Then, the Theory-Context-Characteristics-Methodology (TCCM) framework, a widely adopted method for conducting systematic reviews in management and marketing, is utilized, [18]. It serves as an important resource for identifying gaps in the existing literature and directing future research, as well as for providing a comprehensive overview of the underlying theories, contexts, characteristics, and methodologies in this field employed in prior studies, [19]. For elaborating on the context aspect, the Branding-Inspiring-Convincing-Keeping (BICK FOUR) framework for ARM is used, highlighting four marketing goals aligned with the customer journey. Branding refers to activities aimed at building brand awareness, enhancing product knowledge, and shaping a positive brand image. Inspiration involves triggering new needs and desires in consumers. Convincing focuses on motivating consumers to make purchases. Keeping regard to developing customer loyalty and encouraging continued use, [20]. This research provides valuable insights for both scholars and marketers, offering a foundation for future research work and practical applications. The

novelty of the paper lies in identifying research gaps regarding ARM in the F&B industry. To date, no studies in the literature have simultaneously focused on ARM and the F&B industry while integrating the TCCM and BICK FOUR frameworks.

The structure of this paper is as follows: Section 2 presents a brief background of ARM in the F&B industry. Section 3 gives a detailed description of the methodology used for the selection of articles across three scientific databases, regarding ARM in the F&B industry. Following that, section 4 presents an overview of the selected journal articles, such as the year of publication and the country of origin. Section 5 presents the TCCM framework, highlighting theories, methodological approaches, as well as the areas and contexts of AR applications. The research concludes with the limitations of the study and suggestions for further research on ARM in the F&B sector.

2 Background

ARM is a unique and creative approach to marketing products and services, [21]. Regarding the application of AR in marketing to benefit: consumers, by enhancing their experiences and increasing their satisfaction; businesses, by creating value for the brand, achieving strategic marketing goals, and boosting revenues; as well as societies at large, by promoting job creation and supporting community-based economies, and creating inclusive experiences for people, [20], [22]. ARM is a highly strategic, broad, goal-oriented, interdisciplinary concept that needs detailed exploration. Its application requires its long-term alignment with the business's overall marketing strategy, [20].

The implementation of AR in marketing was initially documented in 2008. Ever since, scholars' and businesses' interest has been increasing in the ARM application and impact, [20], [23]. Current studies show the significance of AR as a novel marketing tool. Replacing traditional advertisements with AR ads helps brands to communicate their advertising content to consumers more effectively, develop emotional reactions and bonds, and encourage product purchases. The immersive and interactive nature of AR enhances consumer engagement, often leading to experience sharing, viral brand promotion, and dissemination through social networks and communities, [23]. However, the extant scholarly research of ARM is at an infant stage, fragmented, and has only sparsely outlined the broader umbrella of AR. A synthesis of the current literature is needed to offer guidance for future research on ARM, [22], [24].

ARM can be adapted for specific contexts of use more than others. It is essential to examine how businesses across various sectors can effectively incorporate this technology into their marketing strategies, as well as assess consumer readiness for AR adoption in different markets, [25]. Moreover, the impact of AR varies depending on consumer characteristics, service categories, and different scenarios. It should be noted that ARM is product-related and can encourage consumers to interact to gain deeper insights into particular product features, [26]. Therefore, businesses should consider the unique attributes of their products when deciding how to implement AR effectively, [18]. Future work could investigate the heterogeneous effects of AR on consumers' responses and behaviors in relation to different products, [22].

Up till now, in the bibliography, some contexts and products are presented extensively (e.g., furniture, tourism, and fashion), whereas others are less or not at all represented (e.g., manufacturing). Examining the transferability of existing AR insights to new industries and product categories would be valuable. Such research could shed light on variations in consumer perceptions and the effectiveness of AR experiences in new sectors, [18].

The potential of AR in the food sector is increasingly explored, particularly in areas related to food production and safety, [27]. Integrating AR into employee training can minimize the risk of critical incidents. New employees can learn to operate complex machinery through simulations, reducing the risk of accidents and machine damage, [28]. By providing ongoing guidance and reminders, they can adhere to proper food preparation processes, enabling them to stay focused on their work, which in turn improves food safety and overall operational effectiveness, [29]. Another example regards the way AR helps food brands to transform traditional packaging into interactive experiences. In [30], it is proposed that wine labels be scanned with a smartphone, so that consumers can access additional content, such as the product's history, serving suggestions, or even virtual tours in winery facilities. This enhances the storytelling aspect of the brand and increases consumer engagement. Another AR application regards restaurants, where interactive menus are transforming the dining experience by encouraging healthier choices, making it more interactive, and helping customers develop better dining habits, [31]. Moreover, studies conducted in grocery stores have revealed that consumers are interested in using AR

to access additional product information, including details like carbon footprint, [18].

Although AR technology will have a significant impact on the food sector, [29], studying ARM literature for the F&B industry is an innovative topic with limited existing research. Till now, there are no reviews that combine AR technology, marketing, and the F&B industry. Specifically for the F&B industry that has special characteristics, such as the inability to "taste" products before purchase, ARM is considered substantial. Not only does it enhance consumers' engagement, but it also enables them to visualize, "taste", and experience the product in an innovative way, [32].

3 Methodology

For this study, the first step was to collect the current literature on ARM in the F&B sector. Three scientific databases were searched, using the PRISMA 2020 methodology, [33] according to the following steps: eligibility criteria: it concerns the inclusion and exclusion criteria that are used; information sources and search strategy: it refers to the scientific databases used and the search terms, keywords, and filters used in the databases to gather the appropriate studies for the review; study selection: it regards the process of choosing which studies will be included in the review, based on the eligibility criteria and search strategy; and results: it summarizes the key insights derived from analyzing the selected studies, [34]. Each of these steps is elaborated upon in the sections below.

- **Eligibility criteria:**

- *Inclusion criteria:* published journal articles on ARM in the F&B industry. Due to the innovative nature of the research topic, no restrictions were applied on the publication year.
- *Exclusion criteria:* manuscripts written in a language other than English; essays and conference proceedings; books or book chapters; and editorials.

- **Information sources and search strategy:**

- The academic research databases Scopus, Web of Science, and Springer Nature were searched early in the year 2025, involving a combination of relevant keywords related to ARM and the F&B industry. These scientific databases were selected since they are among the world-leading bibliographic databases most used in research studies. Springer Nature was used as a complementary source for a broader coverage of relevant literature. The search

engines of these databases provide high-quality content and can be refined by various filters (e.g., subject area, country), [35], [36]. Moreover, they provide the ability to apply the same search criteria across all three databases. This ensured a uniform search process for facilitating the analysis of the retrieved data.

- Then, the databases were searched using appropriate keywords and Boolean operators (i.e., AND, OR) to obtain the most relevant results. Specifically, except for keywords regarding AR, marketing, advertising, and F&B, keywords referring to popular products (e.g., wine, beer, drink, and refreshment) and sectors (e.g., agriculture and restaurant) are commonly used in F&B research as application examples. As illustrated in Table 1 (Appendix), the following search query was used: "augmented reality" AND ("marketing" OR "advertis*") AND ("food" OR "beverage" OR "agricult*" OR "agri" OR "wine" OR "beer" OR "restaurant" OR "drink" OR "refreshment"). For the Scopus and Springer databases, the search criteria were applied to titles, abstracts, and keywords. Similarly, the Web of Science database was searched using the title, abstract, keyword plus, and author keywords.

▪ **Study selection:**

- The identified articles were assessed through a three-phase process, namely by relevance of title, abstract, and keywords, and the content of the full article.

The search (Figure 1, Appendix) returned a total of one hundred and seven (107) studies, namely eighteen (18) of these studies were sourced from the Scopus database, twenty-nine (29) from the Web of Science, while the remaining sixty (60) were obtained from the Springer Nature database. However, the analysis revealed that fifteen (15) of these studies were common in the dataset, resulting in ninety-two (92) unique studies being assessed as eligible. Upon reviewing the title, abstract, and keywords, the analysis determined that forty-four (44) journal articles were not related to ARM and the F&B industry. Consequently, forty-eight (48) journal articles were eligible for further assessment. An MS Excel worksheet was used to record the basic information of the articles (e.g., title, publisher, journal). Finally, the content of the full article was examined by researchers. Sixteen (16)

journal articles were eligible. Since the PRISMA 2020 does not prescribe a minimum number of papers to conduct a review, we proceeded to the final review. Although the corpus of the journal articles included in the study was limited, given that the subject of this study is novel and combinatory of three distinct research areas, robustness and saturation were enhanced through strict screening procedures (e.g., search strings and screening stages), predefined and transparent eligibility criteria (inclusion and exclusion), and structured thematic analysis.

4 Overview

Table 2. (Appendix) provides an overview of the peer-reviewed journal articles on ARM in the F&B industry, published across 7 publishers (Figure 2, Appendix) and 15 journals (Table 3, Appendix). Most cited articles are the ones that study digital sensory marketing and mobile advertising. Among the publishers that stand out are Springer Nature, Multidisciplinary Digital Publishing Institute (MDPI), Elsevier, Taylor & Francis Group, and Wiley (John Wiley & Sons, Inc). Among journals, two articles have been published in "Psychology and Marketing". Also, all papers have an impact factor (2.4 to 9.19); almost half of them have an impact factor higher than 4.0, indicating the quality of the selected papers. The number of journals shows that the literature review sample is of high quality (Table 3, Appendix). Except for one article that was published in 2019, the rest have been published between 2020 and 2024 (Figure 3, Appendix). The extant studies present a geographical limitation, with most of them conducted in Europe. Among those that do, two studies took place in China, one was a joint study between France and the United Kingdom, and others were conducted in Croatia, Germany, Italy, Mexico, the United Kingdom, and the United States (Figure 4, Appendix)

Beyond ARM for the F&B industry, which is expected to dominate, the word cloud of keywords also highlights areas, such as digital and sensory experiences (4 studies) and consumer behavior (3 studies). Also, each of the following keywords is mentioned in two studies: technology, advertising, packaging, sustainability, and consumer experience in virtual environments (Figure 5, Appendix).

5 The TCCM Framework

The TCCM framework (Figure 6, Appendix) is adopted in this work to highlight research gaps and suggest avenues for future investigation, [37]. The framework proposes the four main pillars of research: theory: serves as the foundation upon which study findings are constructed, such as the theories and models presented in marketing, information technology, and psychology; context: refers to the surrounding environment or conditions in which the research is conducted, including aspects, such as the research context, area, focus, scope, and location; characteristics: regards the examination of the content of the article, including key variables like antecedents, mediators, moderators, and outcomes; and methodology: refers to a research approach that involves structured data collection and analysis for empirical studies, [38]. These pillars can assist researchers in systematically understanding the "why" (theory), "where" (context), "what" (characteristics), and "how" (methodology) of prior research, while also offering clear guidance for future studies, [19].

5.1 Theory

The studies use various theories related to consumer behavior, marketing, and technology acceptance (Table 4, Appendix). Four of the studies combine more than one theory in their research. The Technology Acceptance Model (TAM) is the most frequently applied, showing that there is much focus on understanding how consumers accept and use augmented reality technology and how this technology affects the purchasing intention for F&B, [39], [40], [41], [42], [43], [44], [45], [46]. Also, the Sensory Marketing Theory is applied for studying how sensory stimuli affect consumers' attitudes, emotions, behaviors, and decision-making, [47], [48], [49]. Moreover, the Experience Economy Theory is used to provide insights into how businesses can create value through memorable experiences that offer a deeper connection with consumers. In the context of ARM, it is applied for investigating the impact of augmented digital storytelling, [47], [50], [51]. This analysis has shown that current research primarily examines AR from the consumer perspective. In contrast, organizational and strategic management theories appear to be largely underrepresented.

Future research could focus on two directions for explaining the influence of AR on food product choices. On one hand, towards exploring different theoretical frameworks for integrating AR into marketing and consumer preferences, such as the

theory of mental imagery to enhance AR experiences in food marketing, [52]. Also, a combination of theories, such as behavioral theories, could explain particular consumer trends, such as how AR technology can encourage healthy food choices while shopping, [53]. On the other side, expanding theories already applied with new parameters or applying them in new contexts. For example, expanding the TAM model to include emotional and sensory dimensions of AR or the Rhetorical Theory of Advertising, [54] to include interactive and immersive AR experiences in marketing. Also, multisensory theories can be extended to account for virtual and augmented environments, [47]. Experience Economy Theory can be applied to different product categories when using digital humans in storytelling, [50]. The Unified Theory of Acceptance and Use of Technology (UTAUT) model could be applied to measure consumers' acceptance and behavioral intentions of ARM in the F&B industry. In addition, future research could benefit from examining organizational-level and strategic management perspectives to provide a more holistic understanding.

5.2 Context

Regarding the context pillar, Table 5 (Appendix) shows the key AR application areas for F&B, namely menus and ordering; packaging and branding; nutrition, cooking, and recipes; dining experiences; marketing and promotions; food safety and quality control; and beverage customization. Most of the research in these areas is technology-related, but some studies are product-related and brand-related.

Regarding menus and ordering, AR-enabled menus have been established to improve decision-making, consumer engagement, and purchase intention. By allowing diners to view food dishes in realistic detail before ordering, AR supports a more pleasant dining experience, [39], [46], [50]. Another important aspect is packaging and branding, where AR has an important impact on consumer behavior. Interactive packaging attributes and features enabled by AR technologies have the potential to impact product choice and purchase of products, such as milk and sustainable products. Moreover, AR transforms the way marketing messages are sent and received, particularly in products such as wine, with a more interactive and personalized brand experience, [42], [43], [44], [54].

In the area of nutrition, cooking, and recipes, AR software is being implemented to display nutritional information in an interactive format, influencing

healthier decisions. By making nutritional information available, AR is allowing consumers to become better-informed decision-makers when shopping for groceries or cooking, [41], [52]. Enhancing the overall meal experience is another potential use of AR. The integration of AR in meal settings can enhance customer satisfaction by introducing interactive elements or storytelling that increase emotional engagement with the food, [49], [51], [53].

In marketing and promotions, AR is changing advertising strategies. Personalized advertisements catch consumers' attention better, make online experiences more engaging, and make food products look more attractive and worth buying. Also, AR can change negative consumer evaluations by offering pleasant brand experiences, [41], [45], [50]. With regard to food safety and quality control, AR technology provides consumers with real-time product information. By facilitating improved product knowledge through AR, consumers are more likely to make well-informed purchasing choices, [42], [48]. Finally, AR has also been used effectively in beverage customization. By allowing consumers to visualize their beverages before buying, AR enhances consumer engagement, purchase intention, and perceived product value, [43], [54].

The application context of AR includes both online settings and on-site scenarios, [22]. Studies in online and offline contexts are conducted at similar rates, reflecting a balanced presence in the bibliography. For online settings applications, 44% (7 studies) focus on digital or mobile apps, where AR is applied to enhance online experiences, product discovery, or advertisements. For on-site scenarios, 44% (7 studies) focus on the physical retail or in-store environments where AR is implemented to enhance customer engagement and interaction or product perception in real time. Only for two (2) studies, the application context is not mentioned, because the focus is general on sensory science research and supply chain operations (Figure 7, Appendix).

The application of AR in marketing has different types, such as web-based AR, mobile AR (e.g., smartphones and tablets), somatosensory device-based AR (e.g., Kinect), wearable AR (e.g., headsets and smart glasses), and on-site AR, [22]. Notably, among the studies analyzed, mobile AR emerges as the most dominant, accounting for 50% (8 studies). On-site AR follows with 25% (4 studies), indicating its importance in enhancing physical environments, while somatosensory device-based AR represents 19% (3 studies). Wearable AR accounts for 6% (1

study), describing an AR application using Microsoft HoloLens that provides access to nutritional information. Additionally, 6% (1 study) of the studies do not mention the AR type (Figure 8, Appendix).

In the future, scholars should conduct a more in-depth examination of the differences between online and offline experiences with AR, as well as the potential synergy between them. Additional countries and cultural contexts should be explored through research. Furthermore, conducting cross-national and cross-cultural studies is essential to explore how cultural differences and socioeconomic contexts impact consumer behaviors towards augmented digital humans in storytelling advertisements and shape perceptions of AR-based escapism. Additionally, different contexts could be considered to make comparisons in future research. For instance, how ARM differs between B2B and B2C contexts in food distribution, food, beverage, and other industries; fast food and premium food brands; products that require more or less thought before purchase; and in-store and online shopping.

Analyzing the BICK FOUR framework of ARM (Table 6, Appendix), regarding the branding aspect, [54] highlights the use of AR in building brand awareness to engage consumers and create unique experiences. Besides this, they contribute to strengthening the brand image by utilizing disruptive rhetoric. [44] focuses on the global promotion of "Made in Italy" products via AR on building brand awareness and reaching new target groups. On the other hand, in [50], it is aimed to strengthen the brand image by showcasing how digital humans in AR can build a stronger emotional bond with consumers and reinforce the brand identity. [43] gives priority to brand image by providing a more interactive experience, while also reaching new target groups of consumers who are interested in technology.

Concerning the inspiring aspect, [47], [49], [52] underline that AR can be used to create immersive experiences that inspire customers to explore products in new ways. Moreover, [53] highlights the potential of AR technology in emphasizing product features, sparking customers' awareness of needs they did not realize they had.

Regarding the convincing aspect, [39] suggests that by presenting products in an interactive way, AR can generate interest in purchasing them. [40] and, [41] emphasize the ability of AR to showcase the high quality of a product, enhancing its perceived value. The work of [46] underlines the capability of AR to turn interest into immediate action, resulting in increased sales by keeping

customers engaged with the brand long after the purchase.

Concerning the keeping aspect, [45] mentions that AR technology offers characteristics that can help customers use their products, such as visualizing the food packaging in 3D, and providing interactive content that engages consumers. [42] highlights the additional services that this technology provides, which enrich the overall customer experience, such as enhancing transparency in the food supply chain, offering virtual product information, and enabling real-time tracking of food products.

5.3 Characteristics

Following the analysis of the papers regarding the characteristics, it is revealed that various constructs have been examined. Table 7 (Appendix) presents the aggregated antecedents, moderators, mediators, and outcomes. Regarding antecedents, app-related factors as well as consumer-related factors have been studied in articles. Generally, studies mainly include personalization and interactivity in the AR experience. Most studies focus on the user experience and consumer behavior.

Narrative transportation via an augmented digital human is studied, showing that interactive storytelling advertising promotes behavioral intentions. Particularly, perceived human-like augmented digital human storytelling agents contribute to positive consumer responses, such as brand attitudes and word of mouth, [50]. The ability of AR to superimpose food products via the camera of a mobile device can modify how consumers perceive things and affect their actions in the real world. It can generate perceived personal relevance and mental simulation beyond visual stimuli, which acts as a mediator for increasing desirability and purchase intention, [52]. Food-related information delivered through AR can have as an outcome facilitating the selection of healthier food products with a higher nutritional value, [53]. Packaging appearance, product price, brand preference, and product advertising are very strong antecedents that influence the selection and purchasing of food products, such as chocolate, [40].

In [39], AR mobile app advertising is studied, using two constructs, AR app control and AR app design, to measure the use of AR. AR escapism experiences play a powerful mediating role in consumers' responses. Moreover, they highlight the fact that AR mobile app advertising is very effective, and there is no moderating effect of consumers' brand preferences between escapism experiences and consumer responses. Message

framing affects buying behavior. The magic mirror AR application captures considerably more attention and an extended attention span, which allows consumers to read and process text messages. Particularly for organic foods, the framing of the advertisement messages influences the advertising effectiveness if consumers pay enough attention to the presented message. Also, sales are increased when concretely framed, low-construal advertisements are used, [51]. [54] is trying to examine the use of AR as a form of disruptive rhetoric for brand differentiation within the highly competitive case of wine. AR wine labels can create dynamic-immersive experiences that go beyond traditional communication, interactive embodiment, and long-term consumer engagement. Mobile AR, particularly through QR codes and apps, can affect both consumers and businesses in various ways. It can increase consumers' experiences and help in sharing them, and become part of a community, as well as contribute positively to pre-purchase decision-making, increase social and experiential benefits, brand bonding, and product traceability and quality, [44].

Moreover, [45] studies how AR technology can improve negative evaluations by providing a more conducive young consumers' experience than using traditional packaging in the case of takeaway food. In this work, the antecedents are perceived interactivity, perceived vividness, novelty experience, and incentive experience of human-computer interaction. User evaluation, flow, trust, and satisfaction are the mediators between the antecedents and the outcome, i.e., purchase intention. Gender, age, and experience act as moderators. Consumers are more inclined to choose takeaway packages that incorporate AR technology, driven by factors such as trust, satisfaction, or purchase intent. Also, [46] studies the impact of AR online shopping experience on customer purchase intention by extending the TAM model by incorporating five types of AR online shopping experiences. The antecedents, namely sensory experience (i.e., vividness, interactivity, and immersive sensory experience), emotional experience, and behavioral experience, have a significant impact on the mediating variables of perceived ease of use and perceived usefulness. AR provokes positive emotions that strengthen consumers' views of the usability and usefulness of online platforms, leading to greater shopping enjoyment and perceived value. Engaging in action-oriented experiences enriches the shopping journey, resulting in increased purchase intentions among consumers. In turn, the perceived ease of use and

perceived usefulness have a significant impact as mediators on the outcome, which is the purchase intention, with the latter having the stronger impact. [49], tries to study how consumers' food purchase intention is affected by visualization mode (3D vs. AR) and product format (served vs. packaged). Specifically, product format is the antecedent. Mental simulation of eating experiences is considered a mediator of purchase intention. Visualization mode is regarded as a moderator of the mental simulation of eating experiences. Perceived interactivity and immersion are investigated as mediators between product format and mental simulation of the eating experiences. AR visualization of a served food improves mental simulation of the eating experiences and has a positive effect on purchase intention. Also, AR visualization of different packaging has no impact on purchasing intention.

Future studies should focus on consumer preferences for personalized AR experiences in the F&B industry. The characteristics of different consumer groups (e.g., gender and dietary preferences), as well as personality traits (e.g., need for touch), should be studied to identify how they influence the effectiveness of digital food simulations and purchase intentions. More elaboration is needed in personalized digital human agents for creating more engaging stories and enhancing consumer trust. Furthermore, much attention should be given to providing AR content (e.g., types, features) and how it influences food traceability and negative evaluations mitigation. The exploration of combining AR with other technologies, like Virtual Reality (VR) and Artificial Intelligence (AI), to enhance consumer experiences is proposed.

5.4 Methodology

Regarding the methodology used, the majority of the articles, 69% (11 studies), are empirical (e.g., experiments, observations, and data collection) while 19% (3 studies) are theoretical (e.g., reviews and systematic literature reviews), and the remaining 12% (2 studies) combine both theoretical and empirical approaches (Figure 9, Appendix). Specifically, among the empirical studies, one is qualitative, as it involves an analysis of three case studies; ten studies utilize quantitative methods, including questionnaires, surveys, and hypothesis testing, while two employ a mixed-methods approach, combining both qualitative and quantitative methods (e.g., interviews and online surveys) (Figure 10, Appendix).

From the above results, it is shown that there is a gap regarding theoretical and qualitative studies. Future efforts could focus on investigating the use of real-time observations to study the impact of AR on consumer decisions. Future experiments should be designed in a way that will facilitate the distinction of AR impact from other factors that influence shopping decisions. More investigation is needed by combining qualitative and quantitative methods for mapping mental simulation effects. Table 8 (Appendix) analytically presents questions for future research, some of which have also been incorporated as text in the relevant TCCM pillars.

6 Conclusion

ARM strategies can transform the F&B industry with innovative content to augment the real world and engage consumers, [55]. This study seeks to shed light on current research on ARM in the F&B industry. Specifically, it aims to answer research questions regarding the advancements, the application areas and contexts, the methodological approaches and theories applied, and highlight future research opportunities concerning ARM in the F&B industry. Overall, the study offers valuable insights for researchers, marketers, and businesses.

Regarding the research advancements, although limited, there is a meaningful progress in knowledge and applications within ARM in the F&B industry, addressing marketing goals in line with the customer journey (e.g., building brand awareness, inspiring customers, and offering added value to customers through AR content). Concerning the application areas and contexts, most of the researchers' attention has been given to packaging and branding, menus and ordering, dining experiences, and marketing and promotions. The mobile AR dominates. In addition, the differences between online and offline experiences with AR, as well as cross-national and cross-cultural backgrounds, should be explored.

Regarding the methodological approaches and theories, the findings highlight the importance of exploring different theoretical frameworks and expanding existing theories by incorporating new parameters or applying them in different food categories for integrating AR into marketing and understanding consumer preferences for the F&B industry. The study highlights that consumer-centric frameworks, such as the TAM model, are dominating the theoretical research landscape. Examining organizational-level and strategic management perspectives can provide a more comprehensive and holistic understanding of the

ARM landscape. Future research should go beyond consumer acceptance and examine how AR technologies can be integrated into businesses to create long-term competitive advantages. In particular, strategic management theories such as the resource-based view, [56] and dynamic capabilities, [57] could explore how businesses and food retailers can manage their resources to adapt to digital transformation. Moreover, further research is needed that combines both qualitative and quantitative methods to better understand and map consumer decision-making. Also, the literature proposes exploring the integration of AR with other technologies, such as VR and AI, to enhance consumer experiences, taking into account the particularities of the food products (e.g., fresh fruit).

It has to be mentioned that the novelty of this paper, namely, research combining ARM and the F&B industry, provokes limitations regarding the number of studied papers. However, including a small number of high-quality, relevant studies can provide more reliable results in comparison to including low-quality studies for creating a larger sample. Future reviews could include conference proceedings and book chapters. Although using a publisher platform as a complementary source for a broader coverage of relevant literature is a practice found in other reviews in the bibliography, [42], it could create bias in terms of the included content. Therefore, future work could expand the search to additional multidisciplinary databases. Concluding, this field has a growing potential, as ARM in the F&B sector remains largely underexplored; further research is necessary to fully understand the potential of this technology within the industry.

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- Effrosyni Bitakou, conceptualization, methodology, formal analysis, investigation, data curation, writing-original draft preparation, visualization.
- Maria Ntaliani, conceptualization, formal analysis, investigation, writing-original draft preparation, supervision.
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APPENDIX

Table 1. Search strategy and documentation

Database/Website	Query	Filters applied in the Database	Records identified
Scopus http://www.scopus.com/	TITLE-ABS-KEY ("augmented reality" AND ("marketing" OR "advertis*") AND ("food" OR "beverage" OR "agricult*" OR "agri" OR "wine" OR "beer" OR "restaurant" OR "drink" OR "refreshment"))	Document type (Article); Language (English); Subject area (Business, Management and Accounting, Computer Science, Agricultural and Biological Sciences, Engineering, Environmental Science, Multidisciplinary)	18
Web of Science Core Collection http://www.webofscience.com/	ALL=("augmented reality" AND ("marketing" OR "advertis*") AND ("food" OR "beverage" OR "agricult*" OR "agri" OR "wine" OR "beer" OR "restaurant" OR "drink" OR "refreshment"))	Document type (Article); Language (English)	29
Springer Nature https://www.springernature.com/	"augmented reality" AND ("marketing" OR "advertis*") AND ("food" OR "beverage" OR "agricult*" OR "agri" OR "wine" OR "beer" OR "restaurant" OR "drink" OR "refreshment")	Document type (Article); Language (English); Subjects (Virtual and augmented reality, marketing); Disciplines (Business and management, computer science, engineering)	60

Source: created by the authors.

Table 2. The articles used in the final synthesis

No. of citations	Reference	Title of article
14	[50]	Augmented digital human vs. human agents in storytelling marketing: Exploratory electroencephalography and experimental studies
10	[53]	Augmented grocery shopping: fostering healthier food purchases through AR
87	[39]	Augmented reality advertising via a mobile app
2	[40]	Comparison of the Conventional Approach and Augmented Reality on the Purchase and Selection of Food Products
13	[41]	Deep-Learning-Based Adaptive Advertising with Augmented Reality
660	[47]	Digital Sensory Marketing: Integrating New Technologies Into Multisensory Online Experience
49	[42]	Enablers of Augmented Reality in the Food Supply Chain: A Systematic Literature Review
52	[52]	From tablet to table: How augmented reality influences food desirability
60	[51]	Increasing sustainable consumption: message framing and in-store technology
5	[43]	Making paper labels smart for augmented wine recognition
2	[54]	Message on a bottle: the use of augmented reality as a form of disruptive rhetoric in wine marketing
58	[44]	Mobile augmented reality as an internationalization tool in the “Made in Italy” food and beverage industry
170	[48]	Potential applications for virtual and augmented reality technologies in sensory science
27	[45]	The Effect of Using Augmented Reality Technology in Takeaway Food Packaging to Improve Young Consumers’ Negative Evaluations
11	[46]	The impact of AR online shopping experience on customer purchase intention: An empirical study based on the TAM model
86	[49]	We Eat First with Our (Digital) Eyes: Enhancing Mental Simulation of Eating Experiences via Visual-Enabling Technologies

Source: created by the authors.

Table 3. Journal quality metrics

Journal	Impact factor	Quartile (Q)	Reference
Innovative Food Science and Emerging Technologies	6.3	Q1	[48]
Management and Governance	3.3	Q1	[44]
Academy of Marketing Science	9.5	Q1	[52]
Agriculture	3.3	Q1	[45]
Applied Sciences	2.5	Q2	[40]
Foodservice Business Research	3.33	Q2	[42]
Interactive Marketing	9.19	Q1	[47]
International Journal of Retail & Distribution Management	5.5	Q1	[51]
PLOS ONE	2.9	Q1	[46]
Psychology & Marketing	8.9	Q1	[39], [50]
Retailing	8.0	Q1	[49]
Sensors	3.4	Q1	[41]
The Visual Computer	3.0	Q2	[43]
Virtual Reality	4.4	Q1	[53]
Wine Research	2.4	Q3	[54]
Average	5.06	73.3% Q1 / 93.3% Q1-Q2	-

Source: created by the authors.

Table 4. Theoretical lenses

Theory	Description	References
Technology Acceptance Model	Users' adoption of mobile AR technology. Exploring how online AR shopping influences purchase intention by focusing on perceived ease of use, enjoyment, and usefulness.	[39], [40], [41], [42], [43], [44], [45], [46]
Theory of Planned Behavior	Focusing on how AR influences healthier food choices and consumer decision-making by changing perceptions.	[40]
Sensory Marketing Theory	Investigating how sensory input (e.g., touch) influences consumer behavior.	[47], [48], [49]
Rhetorical Theory of Advertising	Examining how AR can disrupt traditional wine marketing techniques as a form of rhetorical strategy, influencing consumer engagement.	[54]
Perception Theory	Examining how visual technologies enhance consumers' mental imagery of food, impacting their purchasing decisions.	[45], [52]
Experience Economy Theory	Highlighting four elements: esthetics, entertainment, escapism, and education, which are applied to measure the impact of augmented digital storytelling.	[47], [50], [51]
Narrative Transportation Theory	Focusing on how immersive storytelling can influence consumer behavior.	[50]
Uncanny Valley Theory	Testing consumer discomfort with human-like digital agents.	[50]

Source: created by the authors.

Table 5. Key AR application areas for F&B

Key Applications	AR	Outcome variable	References
1. Menus and Ordering		Enhanced decision-making, consumer engagement, and purchase intention	[39], [46], [50]
2. Packaging and Branding		Selection and purchase of milk; consumer behavior toward purchasing sustainable products; effectiveness of marketing message delivery and reception in the wine industry	[42], [43], [44], [54]
3. Nutrition, Cooking, and Recipes		Consumer purchases and the healthiness of food choices	[41], [52]
4. Dining Experiences		Consumer satisfaction, consumer experience	[49], [51], [53]
5. Marketing and Promotions		Technology-enhanced consumer engagement and advertising effectiveness; personalized advertising, customer interaction; multisensory online experiences; food desirability and purchase intention; consumer evaluations	[41], [45], [50]
6. Food Safety and Quality Control		Product knowledge	[42], [48]
7. Beverage Customization		Consumer engagement, purchase intention, perceived value	[43], [54]

Source: created by the authors.

Table 6. The BICK FOUR framework of ARM

The BICK FOUR framework of ARM	Research
Branding	
Build brand awareness.	[44], [54]
Strengthen brand image.	[43], [50], [54]
Increase employer attractiveness.	n/a
Reach new target groups with our brand.	[43], [44]
Inspiring	
Inspire customers.	[47], [49], [52]
Generate customer needs.	[53]
Convincing	
Generate buying interest.	[39], [53]
Enforce high willingness to pay.	[40], [41]
Generate sales.	[40], [46]
Promote cross-selling/upselling.	[39], [41]
Keeping	
Increase customer loyalty.	[46], [49]
Improve customer service (after service).	[45]
Offer additional services with products.	[42]
Offer customers added value through AR content.	[43], [53]
Keeping customers in the loop (top of mind).	[39], [44]

Source: created by the authors.

Table 7. Integrative framework

Antecedents	Moderators	Mediators	Outcomes
Narrative transportation via digital human; AR-delivered food information; AR message framing; AR app control; AR app design; Mental imagery via narrative transportation and spatial immersion; Packaging appearance; Product price; Brand preference; Product advertising; AR superimposition; AR magic mirror; AR product labeling as disruptive rhetoric; Mobile AR QR-codes and apps; Perceived interactivity; Perceived vividness; Novelty experience; Incentive experience of human-computer interaction; Sensory experience; Emotional experience; Cognitive experience; Behavioral experience; Relational experience; Food packaging (served vs. packaged)	AR- induced social craving; Prior brand preference; Digitally native consumers; Gender; Age; Experience; Visualization mode (3D vs. AR)	Storytelling immersion via digital human; Escapism experience; Personal relevance; Mental simulation; User evaluation; Flow; Trust; Satisfaction; Perceived ease of use, Perceived usefulness; Perceived interactivity; Immersion	Intention; Pre-purchase Decision-making; Selection of food products and actual purchase; Brand: technology-enhanced experience, attitudes, engagement, bonding, differentiation; Entertainment; Narrative transportation; Word of mouth; Social media sharing; Increase desirability; Attention for advertisement; Dynamic-immersive experiences; Interactive embodiment; Long-term consumer engagement; Experience sharing and community participation; Traceability; Social and experiential benefits

Source: created by the authors.

Table 8. Questions for future research

TCCM	Research questions
Theory	- How does the theory of mental imagery [52] apply to AR experiences in food marketing? - To what extent does experience economy theory [50] apply to different product categories when using digital humans in storytelling? - How does the uncanny valley theory [50] evolve, and what psychological mechanisms could mitigate consumer discomfort? - Which behavioral theories [53] can be combined with AR technology to encourage healthy food choices while shopping? - How does escapism [39] through AR advertising influence brand loyalty? - How can the theory of planned behavior or TAM [40] further explain the influence of AR on food product choices? - How can multisensory theories [47] be extended to account for virtual and augmented environments? - How can the narrative transportation theory [50] be expanded to include immersive technologies beyond AR, such as virtual reality (VR) or mixed reality (MR)? - How can rhetorical theory [54] be expanded to include interactive and immersive AR experiences in marketing? - How can the TAM be extended to include emotional and sensory dimensions of AR?
Context	- How do cultural differences impact consumer behaviors of augmented digital humans in storytelling advertisements [50]? - How does the effectiveness of digital humans in storytelling [50] differ between familiar and new brands? - How does the difference between in-store and online shopping affect the effectiveness of AR tools on food choices? - How do cultural differences affect consumer perceptions of AR-based escapism? - How does the impact of AR on product selection differ across different cultural and socioeconomic contexts? - How does AR advertising affect products that require more or less thought before purchase?

TCCM	Research questions - How does digital sensory marketing [47] differ in industries (e.g., food vs. fashion)? - How does AR implementation differ between B2B and B2C contexts in food distribution? - How does AR affect food desirability across different dietary preferences? - How does AR wine labeling [43] affect consumer choices across different cultural wine markets? - How does the use of ARM in sensory science differ between food, beverage, and other industries? - What are the differences in the effectiveness of AR packaging between fast food and premium food brands?
Characteristics	- How does the human-like appearance of digital agents affect consumer trust and purchase decisions? - Can personalized digital human agents [50] make stories and ads more engaging and effective? - Which characteristics of AR are most effective in promoting healthy food choices across different consumer groups? - What AR content types most affect consumer trust in origin? - Which AR content features most effectively mitigate negative evaluations? - How do consumer personality traits, such as need for touch, influence the relationship between AR and purchase intention? - How do gender and dietary preferences influence the effectiveness of digital food simulations? - How does interactive storytelling [50] compare to linear storytelling in terms of narrative transportation and consumer engagement?
Methodology	- How can experimental designs help isolate the impact of AR from other factors that influence shopping decisions? - What combination of qualitative and quantitative methods best captures mental simulation effects [49]?

Source: created by the authors.

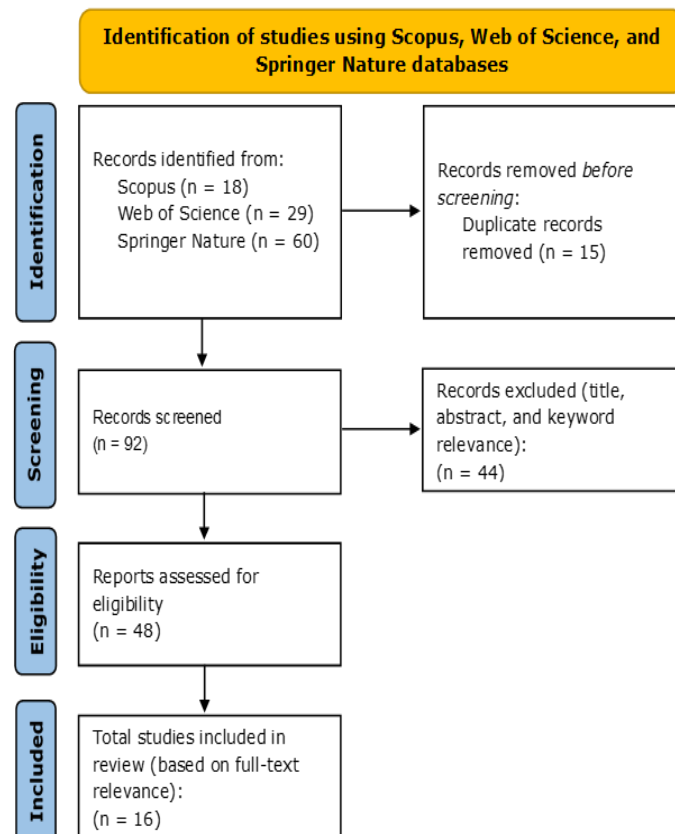


Fig. 1: Flow diagram of the study selection process

Source: created by the authors.

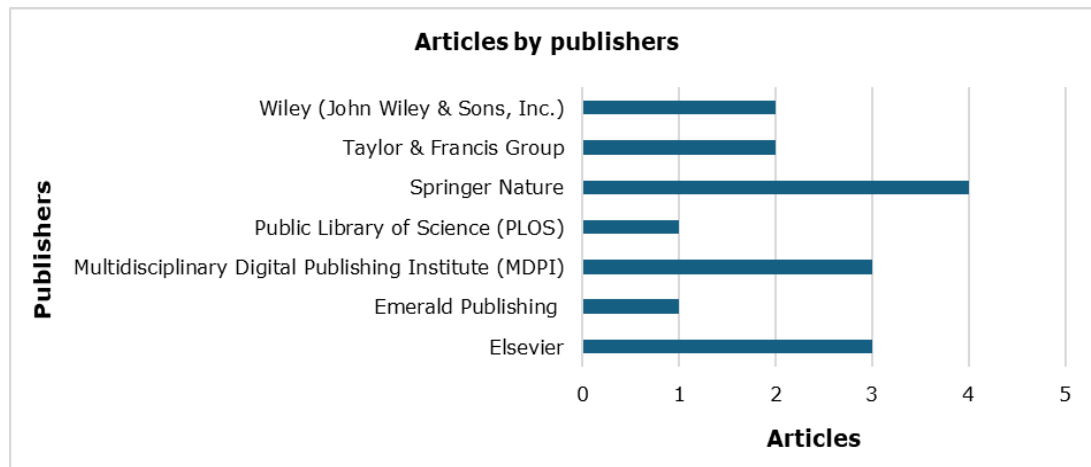


Fig. 2: Number of articles by publishers
Source: created by the authors.

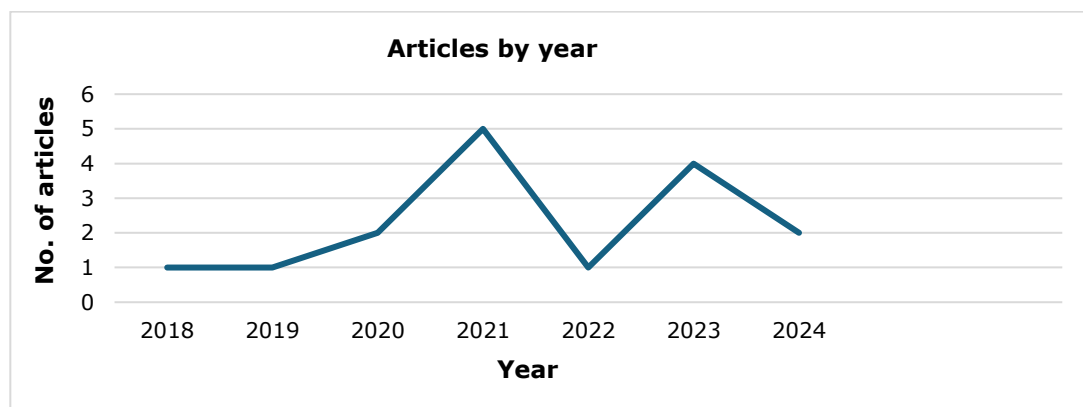


Fig. 3: Number of articles by year
Source: created by the authors.

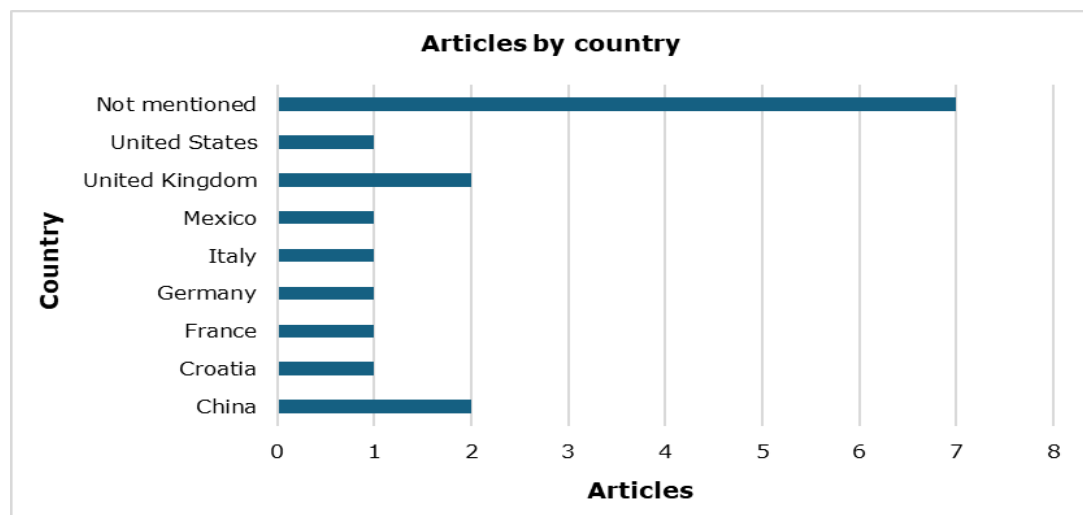


Fig. 4: Number of studies by country
Source: created by the authors.

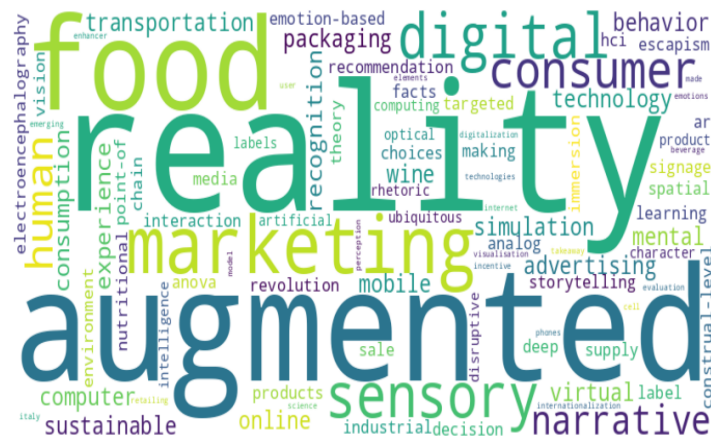


Fig. 5: Word cloud with keywords

Source: created by the authors.

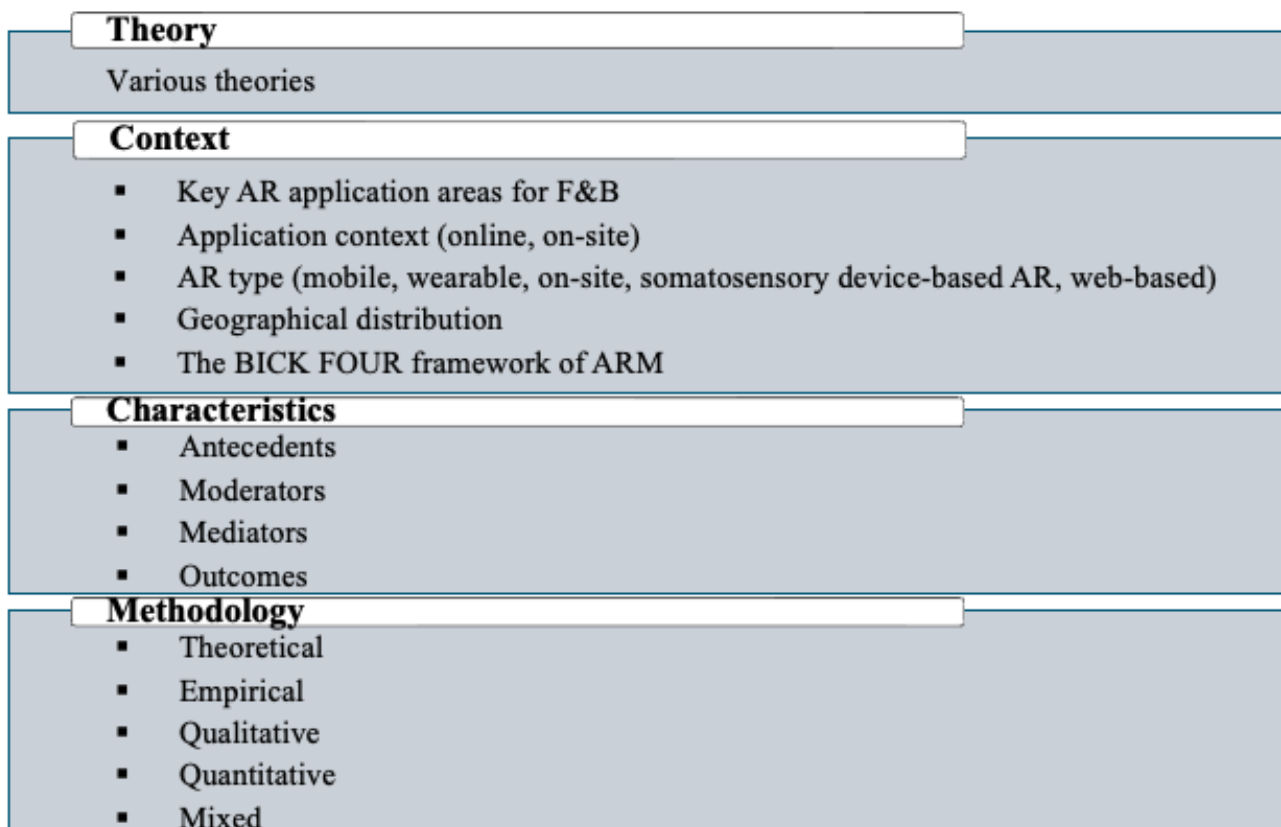


Fig. 6: Application of the TCCM framework

Source: created by the authors.

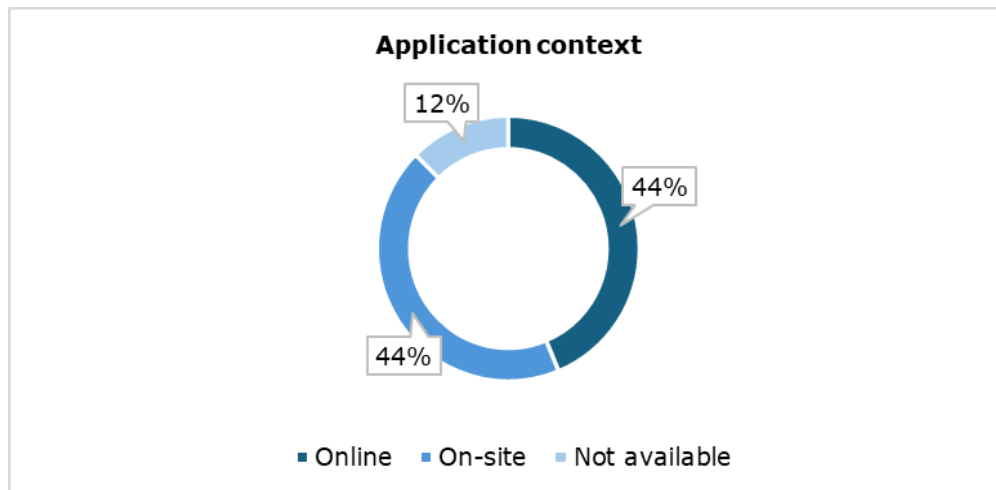


Fig. 7: Application context
Source: created by the authors.

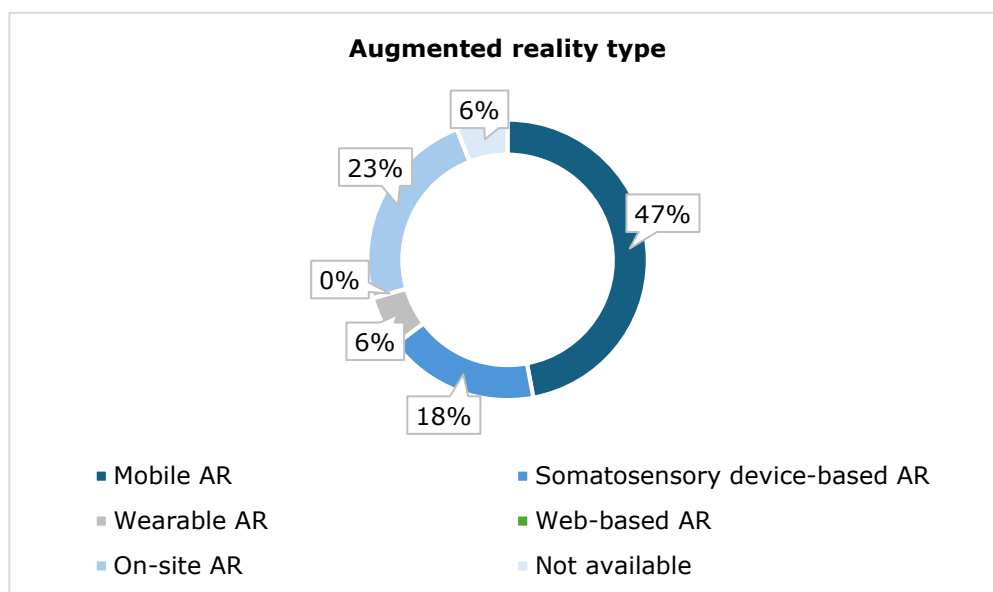


Fig. 8: Augmented reality type
Source: created by the authors.

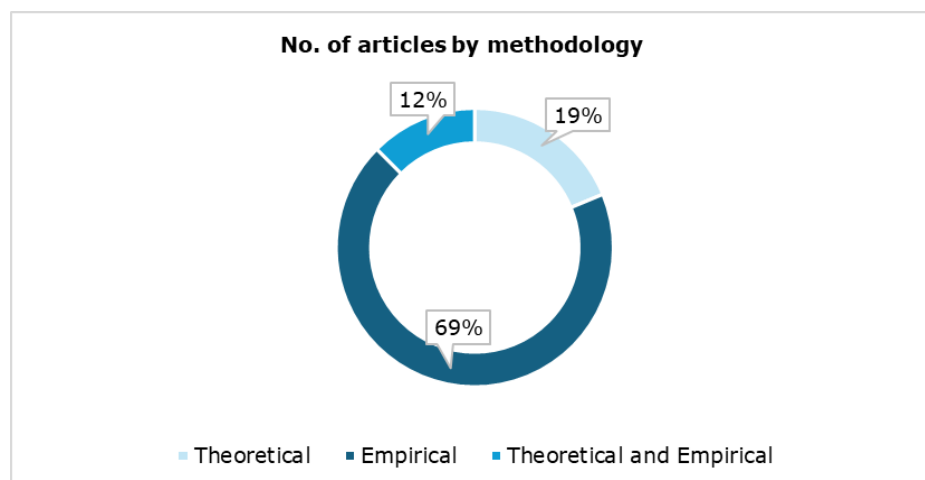


Fig. 9: Number of a rticles by methodology
Source: created by the authors.

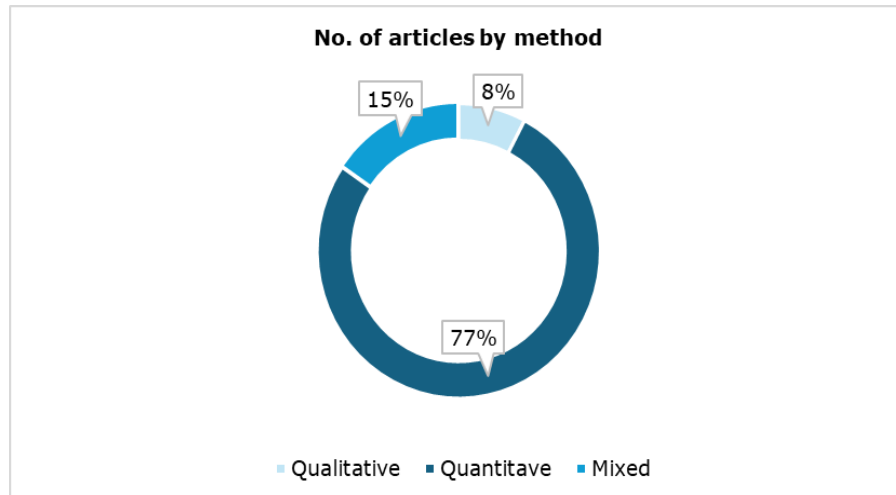


Fig. 10: Distribution of qualitative, quantitative, and mixed studies
Source: created by the authors.